Space Weather Technical Forecast

Issued on Saturday, 10 December 2022 at 01:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increasing Chance of M-class flares and Active electron fluence. Reducing Chance of Minor Geomagnetic Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, although during the second half of the day the frequency of the flares increased as a far side region, responsible for most of the flares, rotated closer to the east limb. The largest flare was a C6 peaking at 09/1413 UTC, from the far-sided region, but a C5 flare also occurred at 09/2242 UTC from AR3157. AR3157 is currently the most magnetically complex region on the disc, with an Esi-beta-gamma-delta classification. Meanwhile AR3153 remains the largest on the disc, in the southwest quadrant. However, over the past 24 hours AR3153 has experienced decay of its intermediate spots, as well as areal decay and a trend for its main leading penumbra to become more symmetric, finishing the period as a Fho/Beta-Gamma. The remaining 5 numbered regions, and a new yet to be numbered region on the southeast limb, are all small, weak, magnetically simple and also relatively stable.

A southeast quadrant filament was seen to lift off in some EUV imagery and Learmonth H-Alpha between 09/0600-0900UTC does not appear to have generated an Earth directed Coronal Mass Ejection (CME). Other events visible on coronagraphs were determined to be far-sided, with perhaps the most notable seen heading eastwards into the UTC afternoon of 9th December, perhaps hinting at an arriving active region in this vicinity. Therefore, no confirmed Earth-bound CMEs were observed in the period.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1 by DSCOVR, were indicative of ongoing connection to the fast wind emanating from CH53/-, and the phi angle was accordingly negative (towards the Sun) throughout. The solar wind speed was Elevated, and generally between 525-550km/s. The solar wind density was level near 10ppcc, while the IMF ranged between 5-8nT. The north-south component ranged from +7 to -6nT. Geomagnetic activity was initially Active (Kp 4), then quickly declined to become Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels.
High energy electron flux (greater than 2 MeV), as observed by GOES16, has been at Background to occasionally Moderate levels, peaking at 139pfu at 09/1915 UTC. The associated 24-hour fluence remained below Active (1e8 integrated pfu), with a level then gradually rising trend. Observed fluence at 10/0001UTC was 1.58e6 integrated pfu.

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Met Office Space Weather Technical Forecast

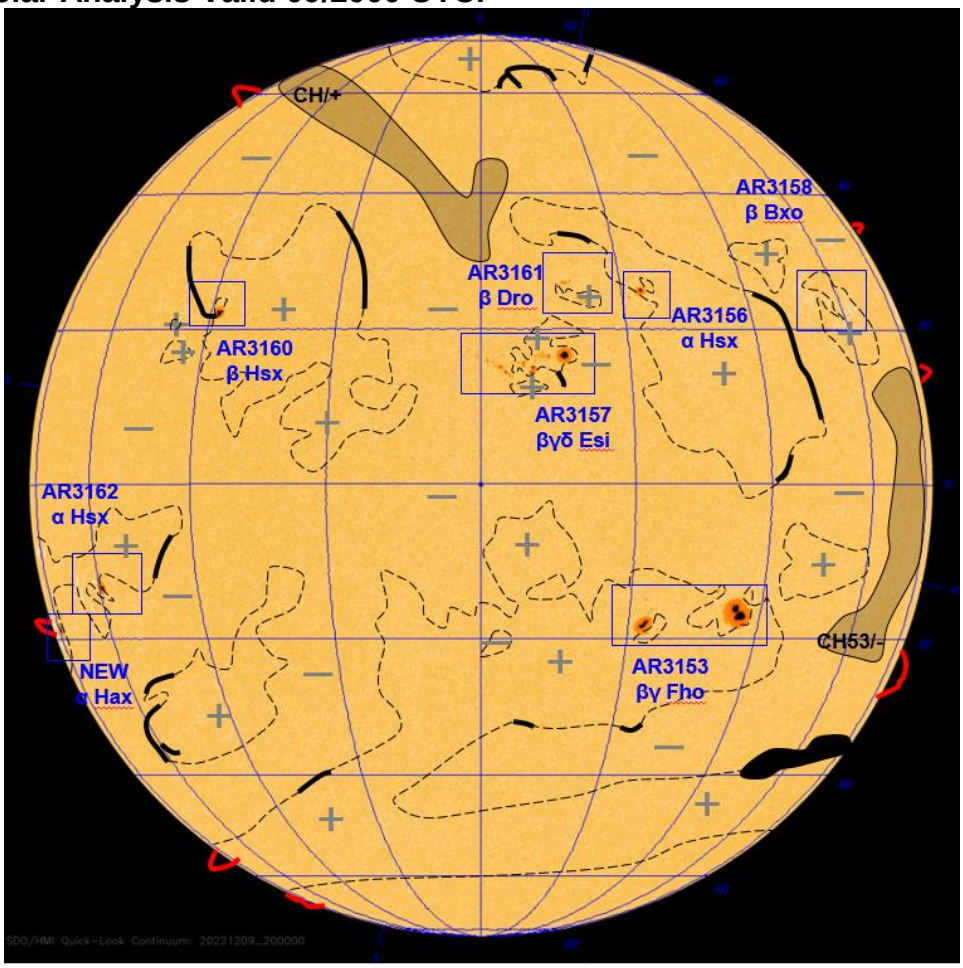
Four-Day Space Weather Forecast Summary

Solar Activity: There is a chance of isolated M-class flares each day, currently most likely from AR3153 or AR3157. However, as an active region on the far side is expected to rotate onto the disc either late today or more likely tomorrow, the chance of significant flares increases slightly.
Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

The only fast wind in the forecast is the incumbent CH53/- high speed stream. Because the IMF is now reducing the peak risk of G1 is now thought to have passed from this feature, perhaps surviving as a vestigial Slight Chance on Saturday, before decaying later in the UTC weekend to leave more reliably Quiet conditions.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to remain at Background levels throughout, with a daily Slight Chance of seeing S1+ levels if any significant flares were to occur.
High energy electron flux (greater than 2 MeV) is expected to remain at predominantly Background to Moderate levels, but with an increasing trend, which brings a chance of occasional High levels (1000 pfu) being reached at times later in the period. The corresponding high energy electron fluence is expected to remain below the Active (1e8 integrated flux) threshold, despite an expected upward trend.

Figure 1. Solar Analysis Valid 09/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in the current forecast.

The solar wind is currently under the residual influence of CH53. Looking upwind to STEREO A, the satellite suggests the solar wind should remain near Elevated levels for at least the coming 24 hours (i.e. around 500km/s), but thereafter a declining trend in the solar wind speed is expected. Quiet to Unsettled (Kp 2-3) geomagnetic conditions, with a chance of isolated Active intervals during the night time periods, are expected today and tomorrow (10th and 11th). Thereafter predominantly Quiet conditions (Kp 0-2) are expected, although during day 4 there is a chance of a slight increase in geomagnetic activity due to a potential HSS arrival. This corresponds to a weak unnumbered northern hemisphere coronal hole feature.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

There are currently eight sunspot regions on the visible disc, including a yet to be numbered region on the southeast limb.
The largest region on the disc, AR3153, after previous fading in its central portion spots, some areal decay and a tendency for its leading group to become more symmetric, has recently been stable. The other main spot group, AR3157, showed little change and maintains a small Delta spot, therefore making it the most magnetically complex on the disc. The remaining numbered sunspot regions are all small, weak and magnetically simple, and generally stable, apart for AR3158 which has faded so much that it is barely visible. The new region on the southeast limb is still emerging and so hard to analyse, but is likely to be larger and more complex than the current estimate of Hax/alpha.

Solar Activity has been Low over the last 24 hours, with C-Class flares. Currently the most likely regions to provide significant flares are AR3153 and AR3157, with a chance of M-class flares. However, but this may change once the new region emerging in the southeast has been properly analysed, plus there is a potential arrival of an active region from the far side.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)

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Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	25	30	30
Very Active	R3 to R5 X Class	No	1	1	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is most likely to remain at Background levels throughout. There remains a daily Slight Chance of seeing S1 or greater levels at GEO if any significant flares were to occur. This risk is mainly due to the influence of AR3153 and AR3157, although neither has a history of producing any proton enhancements. The arrival of possible significant eastern horizon sunspot groups will take some time yet to manifest on proton risks.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is expected to react upwards to the previous Elevated solar wind speeds and ongoing HSS influence, now that the peak threat of associated geomagnetic activity appears to have passed. However, confidence is lower than normal as despite CH53/- being larger and more intense (compared to November), currently the high energy electron flux is showing no signs of the expected increase. Therefore at present the High energy electron flux (greater than 2 MeV) is expected to remain at predominantly Background to Moderate levels, but with an increasing trend, and with a chance of occasionally reaching High levels (1000 pfu) later in the period. The corresponding high energy electron fluence is expected to remain below the Active (1e8 integrated flux) threshold, but with an increasing chance of exceeding Active. Therefore the MOSWOC REFM is considered to be offering reasonable guidance, despite the model currently over-estimating the fluence level.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)

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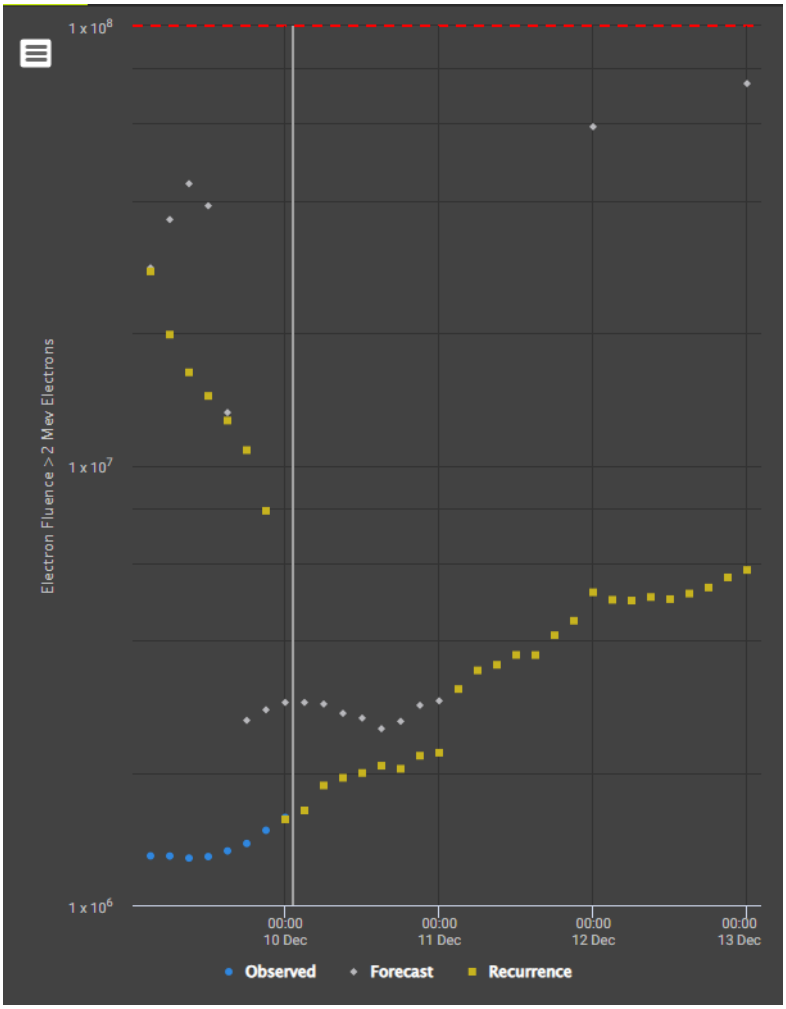
Active	**≥ 2 MeV ≥ 1x10^8**	No	1	20	40	50
Very Active	**≥ 2 MeV ≥ 1x10^9**	No	1	1	1	1

Figure 2: Met Office REFM.



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